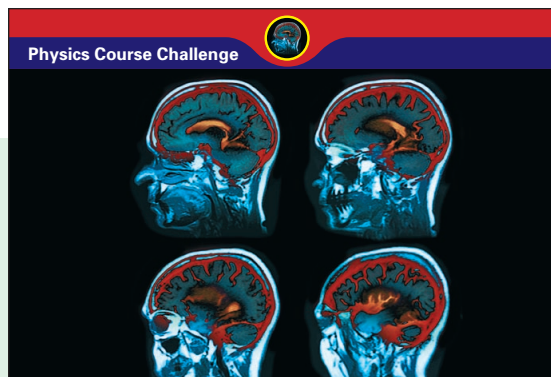


In Unit 5, Matter-Energy Interface, you will explore the challenges of modern physics based on the work of scientists such as Albert Einstein and Niels Bohr. Does time really slow down when an object travels close to the speed of light? What causes some atoms to experience nuclear decay? Can light be modelled as a particle? What is a quark? The answers to these questions are explored in Unit 5.

Following Unit 5, you will find the Physics Course Challenge, Scanning Technologies — Today and Tomorrow. You will apply your skills of inquiry, communication, and analysis to make connections among science, technology, society, and the environment. Your participation in the Course Challenge project will provide you with new insight into an ever-advancing, sometimes controversial technology.



2.0 m?

(b) If the plane has a coefficient of kinetic friction of 0.20, what is the speed of the block after slipping a distance of 2.0 m?

60. (a) Given Earth's radius (6.38×10^6 m) and mass (5.98×10^{24} kg), calculate the escape velocity from Earth's surface.

(b) What is the escape velocity for a satellite orbiting Earth a distance of 2.00 Earth radii from Earth's centre?

(c) How far away do you have to travel from Earth so that the escape velocity at that point is 1% of the escape velocity at Earth's surface? Answer in metres and in Earth radii.

61. A projectile fired vertically from Earth with an initial velocity v reaches a maximum height of 4800 km. Neglecting air friction, what was its initial velocity?

62. An amateur astronomer discovers two new comets with his backyard telescope. If one comet is moving at 38 km/s as it crosses Earth's orbit on its way toward the Sun and the other at 47 km/s, calculate whether each orbit is bound or not.

63. You want to launch a satellite into a circular orbit at an altitude of 10 000 km (above Earth's surface). What orbital speed will it have? What launch speed will be required?

of the Earth-Moon system. [Assume that their mean separation is 3.84×10^8 m.]

(b) Calculate the gravitational potential energy of the Earth-Sun system. [Assume that their mean separation is 1.49×10^{11} m.]

67. Proposals for dealing with radioactive waste include shooting it into the Sun. Consider a waste container that is simply dropped from rest in the vicinity of Earth's orbit. With what speed will it hit the Sun?

68. A rocket is travelling 160 m/s (forward) in outer space. It has a mass of 750 kg, which includes 130 kg of fuel. Burning all of the fuel produces a thrust of 1300 N for 32 s. What is the new velocity of the rocket?

COURSE CHALLENGE

Scanning Technologies: Today and Tomorrow

Consider the following as you continue to build your Course Challenge research portfolio.

- Add important concepts, equations, interesting and disputed facts, and diagrams from this unit.
- Review the information you have gathered in preparation for the end-of-course presentation. Consider any new findings to see if you want to change the focus of your project.
- Scan magazines, newspapers, and the Internet for interesting information to enhance your project.

Watch for Course Challenge cues in the margins as you progress through the textbook. These cues will help you to plan in advance for the Course Challenge, by triggering your thought processes on the subject, pointing out relevant avenues of research, and identifying specific course topics.

You will probably be designing rubrics that your class will use to assess your Course Challenge, so remember to include criteria that will address all of the achievement categories: Knowledge/Understanding, Inquiry, Communication, and Making Connections. As you work on the Challenge, remember to refer to the rubric that will be used to assess your presentation.

This Course Challenge prompts you to examine the costs and benefits of imaging technologies to both the scientific community and society. To help you get started, three fields of scanning technology and some associated issues are presented here.

Medical Issues

Doctors and politicians are often criticized when professional athletes gain access to magnetic resonance imaging (MRI) diagnosis immediately after sustaining an injury, while the general public must often wait months. Questions arise about the real expense of MRI equipment, its availability, and the value of the results as compared to other methods. How does an MRI machine work? What fundamental principles of nature does it exploit? Why is MRI scanning so expensive? Will the costs reduce with time? Will the technology improve with time? Are there better, less expensive options that should be pursued? Will this technology ever be made available to citizens of developing nations? To develop an argument supporting continued use of and research into MRI technology, you need to be able to answer these and other questions.

ASSESSMENT

After you complete this Course Challenge, you will be assessed on

- the quality of your research
- the accuracy and depth of your understanding
- your presentation
- other criteria you decide on as a class